ISSN (electrónico): 1699-5198 - ISSN (papel): 0212-1611 - CODEN NUHOEQ S.V.R. 318

ARÁN

Nutrición Hospitalaria

Trabajo Original

Valoración nutricional

# Screening of nutritional risk: assessment of predictive variables of nutritional risk in hospitalized patients in a second-level care center in Mexico

## *Tamizaje de riesgo nutricional: evaluación de variables predictivas de riesgo nutricional en pacientes hospitalizados en un centro de atención de segundo nivel en México*

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## Abstract

**Introduction:** worldwide, hospital malnutrition constitutes an important issue of morbidity and mortality. Although the prevalence of malnutrition has been calculated as between 7% and 27% in hospitalized patients, its real prevalence remains unknown or underestimated because of the different criteria for its identification and diagnosis. The aim of this study was to determine the prevalence of nutritional risk in a cohort of hospitalized patients and to identify the significance of the predictors associated with nutritional risk.

**Methods:** the evaluation of the presence of nutritional risk was carried out in 247 individuals hospitalized at the second-level care institution Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado (ISSSTE) Zacatecas, Hospital General Nº 26, in Mexico. Nutritional screening was evaluated during the first 24 hours of stay with the NRS 2002. The weighing of associated variables with nutritional risk was calculated statistically using the software Sigma Plot v11.

**Results:** forty-two percent of patients were at risk of malnutrition. Significant associations between nutritional risk and a reduction in food ingestion (during the last week), the illness severity of the patient, as well as age and sex ($p < 0.05$), were observed. A reduction in food ingestion during the previous week increased the likelihood of having nutritional risk 6.67 times more (95% CI: 3.4-13.2; $p < 0.001$) in the studied population.

**Conclusion:** the risk of malnutrition in hospitalized patients at ISSSTE-Zacatecas, Hospital General Nº 26 is frequent (42%). Therefore, early detection of nutritional risk is important to offer for proper nutritional intervention with the objective of decreasing the associated morbidity and mortality.

**Key words:**

Hospital malnutrition. Nutritional risk. Nutritional screening.

## Resumen

**Introducción:** la desnutrición hospitalaria constituye un problema de morbimortalidad en todo el mundo. Aunque la prevalencia de malnutrición se ha calculado entre el 7% y el 27% en pacientes hospitalizados, su prevalencia real sigue siendo desconocida o subestimada debido a los diferentes criterios para su identificación y diagnóstico. El objetivo de este estudio fue determinar la prevalencia del riesgo nutricional mediante la herramienta Nutritional Risk Screening 2002 (NRS-2002) en pacientes hospitalizados y ponderar los factores predictivos asociados con el riesgo nutricional.

**Métodos:** la evaluación de la presencia de riesgo nutricional se realizó en 247 hospitalizados en el hospital general de segundo nivel Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado (ISSSTE) Zacatecas, Hospital General Nº 26, en México. La evaluación nutricional se realizó durante las primeras 24 horas de estadía mediante la herramienta NRS 2002. El análisis de datos se llevó a cabo mediante el software Sigma Plot v11.

**Resultados:** el 42% de los pacientes presentaron riesgo de desnutrición. Después de la corrección por covariables, se encontraron asociaciones significativas entre el riesgo nutricional y una reducción de la ingesta de alimentos (durante la última semana), la gravedad de la enfermedad del paciente, la edad y el sexo ($p < 0,05$). Entre la población estudiada, la reducción de la ingesta durante la última semana aumentó 6,67 veces la probabilidad de presentar riesgo nutricional (IC 95%: 3,4-13,2; $p < 0,001$).

**Conclusión:** el riesgo de desnutrición en pacientes hospitalizados en el Hospital General Nº 26 Zacatecas-ISSSTE es frecuente (42%), por lo que es importante realizar una detección temprana para ofrecer una intervención nutricional adecuada y, con ello, disminuir la morbimortalidad asociada.

**Palabras clave:**

Desnutrición hospitalaria. Riesgo nutricional. Cribado nutricional.

Received: 05/11/2018 • Accepted: 03/01/2019

*Author's contribution: Jorge Luis Gutiérrez-de-Santiago and Sandra Aguilar-Valdez contributed equally to this study.*

Gutiérrez-de-Santiago JL, Aguilar-Valdez S, Casas-Robles ML, Garza-Veloz I, Ortega-Cisneros V, Martínez-Fierro ML. Screening of nutritional risk: assessment of predictive variables of nutritional risk in hospitalized patients in a second-level care center in Mexico. Nutr Hosp 2019;36(3):626-632

DOI: http://dx.doi.org/10.20960/nh.2394

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## INTRODUCTION

Worldwide, hospital malnutrition constitutes a cause of morbidity and mortality and its prevalence is widely contrasting (1). In 2009, a prevalence of hospital malnutrition of around 23% remained constant in European and Oceania countries, like Spain and Australia (2,3). On the other hand, a study published in 2003 showed higher prevalence of malnutrition in Latin America countries, with a variation from 37.0% in Chile to 61.9% in Argentina (4), respectively.

Hospital malnutrition increases the period of hospital stay, as well as treatment costs for patients and the families who support them (5,6). In the same manner, the presence of malnutrition in patients increases comorbidities, the need for surgical procedures, medical interventions and treatments, as well as gastrointestinal symptoms, changes in corporal composition and low dietary daily ingestions (7), among others.

Although the prevalence of malnutrition had been calculated between 7% and 72% of hospitalized patients, its real prevalence remains unknown or is underestimated, because of different criteria used for its identification and diagnosis, as well as the time it gets evaluated during the course of the patient hospitalization (8,9).

The elements more commonly used in the screenings of hospital malnutrition include recent weight loss, decreased daily dietary ingestions during the previous days and the severity of illness (8,10). One of these screenings with better acceptance in recent years to evaluate the risk of hospital malnutrition is the Nutritional Risk Screening 2002 (NRS-2002) (11,12). This screening test involves two sections, an initial evaluation consisting of four basic questions: body mass index (BMI) less than 20.5 kg/m$^2$, weight loss in the last three months, reduction of dietary intake in the last week, and severity of the patient. If any of the results for these questions are affirmative, a final evaluation where the severity of these items is deepened and scored is considered (11). This tool has been used globally in different hospital specialties, such as in pulmonary clinics (13) where it was concluded that the NRS is a more sensitive predictor than BMI to diagnose the risk of malnutrition. These authors also found that a high nutritional risk was related to a longer hospital stay (10.2 ± 9.5 *vs* 5.4 ± 6.0 days; $p < 0.001$). In other medical conditions such as Crohn's disease, this screening can be used to determinate the nutritional risk as the disease progresses and its relationship with comorbidities present (14). Another application of the NRS is to evaluate the nutritional risk in postoperative patients. An example is the study performed by Boban et al. in patients who had undergone heart surgery and in which a 96% prevalence of nutritional risk was observed (15). In Mexico, only a few studies have been carried out, mainly in patients with cancer, where the effectiveness of this nutritional tool was evaluated and the prevalence of nutritional risk in the study population was calculated. The results showed a high prevalence of nutritional risk of about 50% in the study population (16,17).

Second-level care centers, in Mexico, serve the majority (~65%) of the health problems and needs that require hospital admission or emergency attention (18) and, notwithstanding its big limitations, BMI is the variable used in most of these healthcare institutions for the estimation of nutritional status (19). Accordingly, and considering the evidence that nutritional risk is a major problem in worldwide hospitals, the objective of this study was to determine the prevalence of nutritional risk using the guidelines of the NRS 2002 in hospitalized patients at the second-level care institution Hospital General No. 26 of Zacatecas-ISSSTE, in Mexico. The weighting of the predictors associated with nutritional risk was also determined. The generation of this data could more accurately show the type of nutritional support required by these patients and, thus, reduce the risk of malnutrition during their hospital stay.

## MATERIALS AND METHODS

### STUDY DESIGN AND ETHICAL CONSIDERATIONS

This transversal and prospective study was carried out in Zacatecas, Mexico. Patient selection was done within the departments of Clinical Nutrition, Hospitalization, Internal Medicine, Surgery and Gynecology of the Hospital General de Zacatecas-ISSSTE between February and March 2018. All hospitalized patients (n = 247) where included. No exclusion criteria were considered for the study. All participants provided written informed consent for their participation in the study, in accordance with the Declaration of Helsinki. The protocol was approved by the Research Ethics Committee of the Academic Unit of Human Medicine and Health Sciences of the Universidad Autónoma de Zacatecas (approval ID: CEB-R-1002-2017).

### NUTRITIONAL RISK ASSESSMENT

Anthropometric data were obtained. Weight and height were determined without shoes, using a scale (Tanita® BC533: with a maximum capacity of 150 kg and a precision of 100 grams) and stadiometer (precision of 1 mm) calibrated. In patients who could not stand on their feet, height was estimated according to the length of the forearm with subsequent conversion to height. In case of weight, armchairs with swing arm were used. Otherwise, and when height measurement was not possible, previous estimation formulas were used (20,21). BMI was calculated using weight and height measures as follows: BMI = weight in kg / height in m$^2$. The BMI variable was used to classify the patients as underweight (BMI < 18.5), normal weight (BMI ≥ 18.5 to ≤ 24.9), overweight (BMI ≥ 25 to < 30) and obese (BMI ≥ 30) (22). This classification was used for all age groups. The evaluation of presence of nutritional risk was made during their first 24-48 hours after admission with the screening tool NRS 2002 (11). Briefly, for the NRS 2002 nutritional risk determination, an initial evaluation was included consisting of the four basic questions: BMI less than 20.5 kg/m$^2$, weight loss in the last three months, reduction of dietary intake in the last week, and the severity of the patient's disease. If any of the previous questions was affirmative, a final

evaluation where the severity of the first items was deepened and scored later. If the score was greater than or equal to three, the patient was considered to have nutritional risk. Personal and complementary clinical data were obtained from the clinical records of each patient.

## DATA ANALYSIS

Analysis of data was carried out by comparing clinical and personal characteristics using Chi-square or Fisher's exact test for categorical variables, and Student's t-test, Mann-Whitney U test or ANOVA as appropriate, for numerical variables. The odds ratio (OR) was calculated for positive associations. Multivariate logistic regression was used to evaluate the risk predictors using NRS as the dependent variable. p values $< 0.05$ were considered as statistically significant. Data analysis was conducted using Sigma Plot v.11 (Systat Software Inc., San Jose, CA) software.

## RESULTS

A total of 247 patients were included in this study; 146 of them (59.0%) were women (Table I). The average age of the study population was 60.34 years (± 19.05) and 35.6% of the participants were above the age of 70 years old. The average BMI in the study population was 26.97 kg/m$^2$ (± 5.50) and 83.4% showed BMI above or equal to 20.5 kg/m$^2$. In all, 33.6% indicated having weight loss in the previous three months and 34.4% of the study population decreased their food intake in the previous week. The severity of illness in 49.8% of the patients was classified as mild (Table I).

The results of the NRS assessment in the study population classified by groups as NRS (+) or NRS (-) are shown in table I. One hundred and three patients (41.7%) were at risk of malnutrition (NRS+) and 144 (58.3%) were NRS (-). Among the patient population, 65.3% of patients without nutritional risk were women. The average BMI of the NRS (+) population was 27.72 kg/m$^2$, which placed them in the overweight diagnosis with two units above patients without risk (Table I). As expected, NRS variables (risk factors) that were included in the screening such as severity of the patient disease, decreased nutritional intake and recent weight change showed differences between study groups (p values $< 0.001$).

To identify the risks associated with the differences in proportions of NRS variables between groups of NRS (+) and NRS (-), an odds ratio analysis was carried out. The results of this analysis are shown in table II. The decrease in dietary ingestion during the previous week was associated with hospital malnutrition, increasing the probability of having malnutrition 7.9 (95% CI: 4.3-14.5; $p < 0.001$) times in the study population. Loss of weight during the past three months showed a six (95% CI: 3.4-10.9; $p < 0.001$) times increased risk of malnutrition. BMI below 20.5 kg/m$^2$ increased the probability of risk of malnutrition by 2.9 times among the study population (95% CI: 1.3-7.0; $p = 0.011$). The variable sex was significantly different between study groups ($p = 0.020$), showing a protector effect against the disease and, accordingly, being a woman decreased the probability of suffering malnutrition 0.5 (95% CI: 0.3-0.9; $p = 0.02$) times in the study population (Table II).

The illnesses prone to development of hospital malnutrition were cancer (81.5%), lung disease (75.0%), chronic kidney disease (66.7%), liver diseases (75.0%) and cardiovascular disease (59.4%), whilst the ones with minor risk were the disorders associated with pregnancy, gonarthrosis and polytrauma (Fig. 1).

Only 6% of the patients at risk of suffering malnutrition had a low BMI (16.30 ± 1.97 kg/m$^2$), whereas a few more than the half suffered from being overweight or obese (30.00 ± 4.57 kg/m$^2$) (Fig. 2).

Finally, to evaluate the weighting of the variables with differences between groups, a multivariate logistic regression analysis was performed considering the NRS status as the dependent variable. The results of this analysis are displayed in table III. After statistical correction, decreased food ingest in the past week, severity of patient disease, age and sex were the variables that had significant p values in the analysis. Patients who decreased their food ingestion in the previous week had 6.7 times higher risk to be NRS (+) in the study population ($p < 0.001$; 95% CI: 3.39-13.19). Sex remained as a protector factor for malnutrition in the study population ($p = 0.006$; OR = 0.394; 95% CI: 0.20-0.76).

## DISCUSSION

The prevalence of hospital malnutrition in Mexico affects nearly half of hospitalized patients, showing interstate dispersion as well as between institutions and being an important factor that negatively contributes to the recovery of the patient and increases the time of their hospital stay (10). Risk factors of this condition may be modified by taking the appropriate nutritional measures. Timely identification of patients who are at risk provides an opportunity to take appropriate actions to prevent the occurrence and/or the progression of malnutrition, and therefore, decreases the associated morbidity and mortality. Accordingly, the objective of this study was to determine the prevalence of nutritional risk through the NRS 2002 in hospitalized patients in the second-level care center Hospital General - ISSSTE in Zacatecas, Mexico. The weighting of the predictors associated with nutritional risk was also determined. In this study, 42% of patients were in risk of malnutrition. Previous reports have shown that the prevalence of hospital malnutrition in Mexican hospitals can vary from 23% to 65% (23,24). In spite of the fact that our data threw out that 42% of patients were suffering from malnutrition, positioning this number inside the range mentioned, it is important to mention that the population attending the Hospital General - ISSSTE is not representative of all the country's population in its entirety. The Hospital General - ISSSTE is part of the Mexican health insurance system, and those who are accredited have a relatively high economic level compared to the people covered by other types of social insurance such as "popular insurance" (designed for the general public, predominantly comprised of people with limited economic resources)

**Table I.** Characteristics of study population classified by risk groups

| Characteristic | General (n = 247) | NRS (+) (n = 103) | NRS (-) (n = 144) | p-value |
|---|---|---|---|---|
| Age (years) | 60.34 ± 19.05 | 66.56 ± 17.83 | 55.89 ± 18.70 | < 0.001 |
| **Sex** | | | | |
| Women n (%) | 146 (59.1) | 52 (50.5) | 94 (65.3) | 0.020 |
| Men n (%) | 101 (40.9) | 51 (49.5) | 50 (34.7 | |
| BMI (kg/m$^2$) | 26.97 ± 5.50 | 25.92 ± 5.78 | 27.72 ± 5.19 | 0.003 |
| **BMI** | | | | |
| < 20.5 kg/m$^2$ | 27 (10.9) | 19 (18.5) | 8 (5.6) | 0.011 |
| ≥ 20.5 kg/m$^2$ | 206 (83.4) | 78 (75.7) | 128 (88.9) | |
| **Weight loss (past 3 months)** | | | | |
| Yes n (%) | 83 (33.6) | 57 (55.3) | 26 (18.1) | < 0.001 |
| *No n* (%) | 150 (60.7) | 40 (38.8) | 110 (76.4) | |
| *NA n* (%) | 14 (5.7) | 6 (5.8) | 8 (5.6) | |
| **Decrease in food intake (last week)** | | | | |
| Yes n (%) | 85 (34.4) | 61 (59.2) | 24 (16.7) | < 0.001 |
| No n (%) | 148 (59.9) | 36 (38.8) | 112 (77.8) | |
| NA n (%) | 14 (5.7) | 6 (5.8) | 8 (5.6) | |
| **Serious patients** | | | | |
| Yes n (%) | 53 (21.5) | 39 (37.9) | 14 (9.7) | < 0.001 |
| No n (%) | 180 (72.9) | 58 (56.3) | 122 (84.7) | |
| NA n (%) | 14 (5.7) | 6 (5.8) | 8 (5.6) | |
| **Damage in nutritional status** | | | | |
| Normal n (%) | 139 (56.3) | 27 (26.2) | 112 (77.8) | < 0.001 |
| Mild n (%) | 75 (30.4) | 51 (49.5) | 24 (16.7) | |
| Moderate n (%) | 11 (4.5) | 11 (10.7) | 0 (0.0) | |
| Severe n (%) | 8 (3.2) | 8 (7.8) | 0 (0.0) | |
| NA n (%) | 14 (5.7) | 6 (5.8) | 8 (5.6) | |
| **Severity of illness** | | | | |
| Normal n (%) | 52 (21.1) | 11 (10.7) | 41 (28.5) | < 0.001 |
| Mild n (%) | 123 (49.8) | 51 (49.5) | 72 (50.0) | |
| Moderate n (%) | 53 (21.5) | 30 (29.1) | 23 (16.0) | |
| Severe n (%) | 5 (2.0) | 5 (4.9) | 0 (0.0) | |
| NA n (%) | 14 (5.7) | 6 (5.8) | 8 (5.6) | |
| **Age** | | | | |
| Age > 70 n (%) | 88 (35.6) | 55 (53.4) | 33 (22.9) | < 0.001 |
| Age ≤ 70 n (%) | 48 (64.4) | 48 (46.6) | 111 (77.1) | |

**p-value obtained from the comparison between NRS (+) and NRS (-) groups. NRS: Nutritional Risk Screening; BMI: body mass index; NA: no data available.*

and/or Instituto Mexicano del Seguro Social (IMSS). Therefore, the actual prevalence of nutritional risk in Mexico could be higher than that reported in our study.

Regarding hospital malnutrition data in other Latin America countries, in a general hospital from Peru, Veramendi-Espinoza et al. evaluated the prevalence and factors associated with hospital malnutrition in 211 patients from medicine and surgery services. Their results showed a prevalence of hospital malnutrition of 46.9% and they identified an association between the number of comorbidities of the patient and the presence of malnutrition, and between the time of change of dietary intake and malnutrition (25). In agreement with our results, the authors found that women had a lower risk of malnutrition (OR = 0.36, 95% CI: 0.18-0.71 *vs* OR = 0.52, 95% CI: 0.32-0.91) and that a decrease in dietary intake

**Table II.** Determination of odds ratios

| Characteristics | NRS (+) (n = 103) | NRS (-) (n = 144) | p-value | Odds ratio | 95% CI |
|---|---|---|---|---|---|
| *Sex* | | | | | |
| Women n (%) | 52 (50.5) | 94 (65.3) | 0.02 | 0.52 | 0.32-0.91 |
| Men n (%) | 51 (49.5) | 50 (34.7 | | | |
| BMI | | | | | |
| < 20.5 kg/m$^2$ | 19 (18.5) | 8 (5.6) | 0.011 | 2.948 | 1.25-6.98 |
| ≥ 20.5 kg/m$^2$ | 78 (75.7) | 128 (88.9) | | | |
| *Weight loss (last 3 months)* | | | | | |
| Yes n (%) | 57 (55.3) | 26 (18.1) | < 0.001 | 6.029 | 3.35-10.86 |
| No n (%) | 40 (38.8) | 110 (76.4) | | | |
| NA n (%) | 6 (5.8) | 8 (5.6) | | | |
| *Decrease in food intake (last week)* | | | | | |
| Yes n (%) | 61 (59.2) | 24 (16.7) | < 0.001 | 7.907 | 4.32-14.46 |
| No n (%) | 36 (38.8) | 112 (77.8) | | | |
| NA n (%) | 6 (5.8) | 8 (5.6) | | | |
| *Severity of patient disease* | | | | | |
| Yes n (%) | 39 (37.9) | 14 (9.7) | < 0.001 | 5.86 | 2.95-11.64 |
| No n (%) | 58 (56.3) | 122 (84.7) | | | |
| NA n (%) | 6 (5.8) | 8 (5.6) | | | |
| *Age* | | | | | |
| Age > 70 n (%) | 55 (53.4) | 33 (22.9) | < 0.001 | 3.854 | 2.23-6.67 |
| Age ≤ 70 n (%) | 48 (46.6) | 111 (77.1) | | | |

**p-value for the odds ratio. NRS: Nutritional Risk Screening; BMI: body mass index; NA: no data available.*

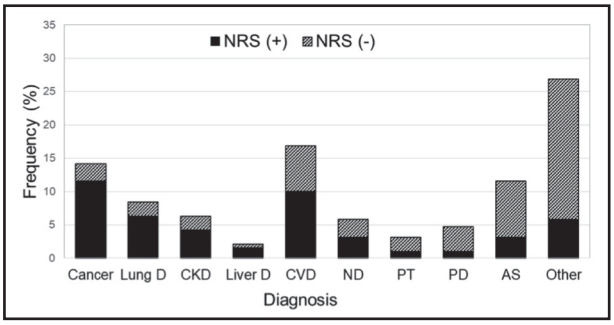


**Figure 1.**

Diagnosis distribution in the study population (D: disease; CKD: chronic kidney disease; CVD: cardiovascular disease; ND: neurological disease; PT: polytrauma; PD: diseases associated with pregnancy; AS: abdominal surgeries).

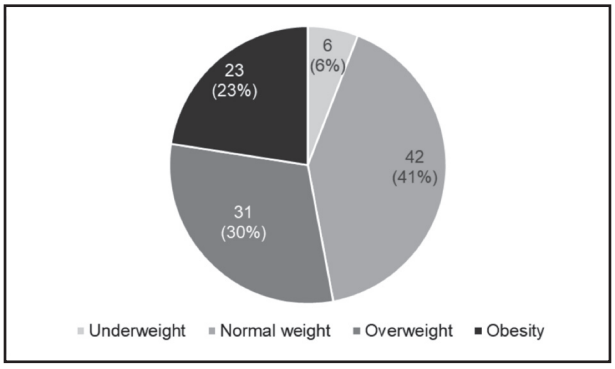


**Figure 2.**

Diagnosis of nutritional risk using BMI. Considering only the NRS (+) group, the subjects were classified according to their BMI to evaluate their nutritional status. The pie diagram displays the results obtained for patients classified as underweight, normal weight, overweight and with obesity (n = 102).

during the previous week was strongly associated with the risk of malnutrition (p = 0.031 *vs* p < 0.001 in our study).

In our study, considering only the subjects with cancer diagnosis, 81.5% of them were in risk of malnutrition. In a previous study, Álvarez-Altamirano et al. evaluated the nutritional status of Mexican patients with a diagnosis of cancer using the NRS-2002 test, identifying that 50.2% of the patients presented nutritional risk (16). However, the prevalence of nutritional risk in patients with a cancer diagnosis in our study was higher than that reported by Álvarez-Altamirano et al.; in both studies the prevalence data in these group of patients are considerably high. The cause may be related to increased caloric expenditure in these patients because of this pathology and the aggressiveness and/or side effects of the pharmacological treatments (26,27). Interestingly, BMI in both populations was very similar (27.12 ± 5.14 kg/m$^2$ *vs* 26.97 ± 5.50 kg/m$^2$), reflecting the high prevalence of being overweight in both populations (16). In our study, to compare the usefulness of BMI in the establishment of nutritional risk in hospitalized

**Table III.** Determination of predictors

| Variable | Coefficient | Standard error | Wald statistic | p-value | Odds ratio | 95% CI |
|---|---|---|---|---|---|---|
| Constant | -2.48 | 0.651 | 14.511 | < 0.001 | 0.084 | 0.02-0.30 |
| Decrease in food intake (last week) | 1.9 | 0.347 | 30.002 | < 0.001 | 6.684 | 3.39-13.19 |
| Severity of patient disease | 1.214 | 0.395 | 9.459 | 0.002 | 3.367 | 1.55-7.30 |
| Age | 0.0269 | 0.00929 | 8.369 | 0.004 | 1.027 | 1.00-1.05 |
| Sex | -0.932 | 0.336 | 7.692 | 0.006 | 0.394 | 0.20-0.76 |

**Odds ratio obtained from multivariate logistic regression analysis using NRS as the dependent variable.*

patients, BMI values (without age-related BMI classification) were compared with the NRS results. As previously reported, BMI alone showed not to be a good classificatory tool for the assessment of nutritional risk, detecting only a 6% of the patients at risk of suffering malnutrition (16) (Fig. 2).

Finally, two considerations should be highlighted:

1. According to the Global Leadership Initiative on Malnutrition (GLIM) consensus, NRS screening does not meet all the desirable criteria for nutritional risk analysis, since it does not include important aspects in the evaluation such as body composition, presence of edema, muscle function and biochemical data. Even though this information could provide an accurate classification of the disease, the NRS complies with four of the five main criteria agreed upon by the committee (non-volitional weight loss, low BMI, reduction of food intake and disease burden, while a reduction in muscle mass was absent) (8). Therefore, this consideration should be taken into account to extrapolate our results.
2. In our study, the risk factors included in the NRS were evaluated by establishing which of them had greater weight for the development of this condition. In addition, BMI as a continuous variable was also included, confirming that diagnosis by BMI is not a good predictor to assess nutritional risk in the hospitalized population. However, the shortcomings of the study were not having included more risk factors in addition to those included in the screening; this could give a broader picture to determine the genesis of hospital malnutrition. Accordingly, is widely recommended to pay more attention to hospital malnutrition, both in diagnosis as well as in treatment, taking into account the main risk factors. This would reduce costs for the hospitals, time of stays and mortality of the patients.

## CONCLUSIONS

Forty-two percent of the studied population was at risk of suffering hospital malnutrition. The main risk factors identified were decreased food intake during the previous week and a weight loss during the previous three months. Female sex was identified as a protector factor against this disorder. The implementation of an effective screening test for nutritional risk to all populations who are hospitalized in Mexican health institutions is highly recommended to offer proper nutritional intervention with the objective of decreasing the associated morbidity-mortality.

## CONFLICTS OF INTEREST

The authors declare that they have no competing interests. The authors are responsible for the content and writing of the research paper. The manuscript edition costs were covered in part by the Academic Unit of Human Medicine and Health Sciences-UAZ support (to CA-UAZ-207).

## ACKNOWLEDGMENTS

We thank all the study participants. The authors appreciate the contributions from Dr. Alejandro Valdez Bonilla and Dr. René Padilla, directors of the Hospital General – ISSSTE, for their help to carry out the study. The technical support of the Department of Education of the Hospital General - ISSSTE is also recognized.

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